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SCIENCE AND SOCIETY IN THE ATOMIC AGE

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SCIENCE AND SOCIETY IN THE ATOMIC AGE

[Following is the translation of an article by N. N. Semenov entitled "Nauka i obshchestvo v vek atoma" (English version above) in "Voprosy filosofii" (Problems in Philosophy), No.7, 1960, Moscow, pages 24-33.]

Social progress is characterized by the degree of man's mastery over the forces of nature and his ability to utilize them in the interests of humanity. The most important function in the resolution of these problems belongs to natural sciences, that help in the mastering of the forces of nature, in improving production and in raising labor productivity.

Some bourgeois scientists hold that such a definition of the function of science suffers from being too utilitarian and makes a fetish of production. The entire history of science, however, from the most ancient times confirms the correctness of such a definition. It holds true for every stage of social development. The effect of

scientific discoveries, and of their concomitant technical progress, on life shows itself in different ways for different social-economic structures, in particular, under capitalism and under socialism.

In a socialist society, an increase in labor productivity leads directly and immediately to a higher living standard and to a shortening of the working day. Thus, under a socialist, and even more so, under a communist society the social function of science is the attainment of human welfare.

Under a capitalist regime, on the other hand, improvement of production and increased labor productivity have as an immediate object the raising of profits of the owners of the means of production.

The main cause of scientific progress (in the final analysis) is the need to develop production. Science, however, has its own objective - the profound study of nature, the exposing of the inner mechanism of phenomena. In solving fundamental scientific problems, scientists open up ever newer avenues to the mastery of the forces of nature.

In the past 20 years scientific and technical development has been on a hitherto undreamed of scale. Previously unknown, deeply imbedded laws of nature have been uncovered. New possibilities for the development of production

have been found, that people did not suspect existed. More than that, it would appear that chain nuclear reaction does not occur anywhere in the universe, while thermonuclear reactions take place only in the incandescent heavenly bodies. Science has introduced into life the new atomic engineering and industry. Electrical and radio engineering in their day emerged in the same manner. All of this confirms the thought that today the role of science in social development has become so important that it may be rightly looked upon as a force that is powerful in its effect on production. And it is not possible even to foresee at present the dizzy speed with which our possibilities of further mastering the forces of nature will increase.

What are the basic propects for the development of modern science, that are indicative of its role as a powerful weapon for progress?

The scientific and technical progress that is indicated for the coming 30 to 40 years, is capable of fully satisfying the material and spiritual needs of man, and ensuring a rounded develo ment of his creative forces and abilities.

One of the basic indicators of the level of industrial development is the amount of energy that is being produced, especially electric power energy - the most universal

form of energy from the standpoint of possibilities of industral use.[1] Established electric power energy in the world today amounts to about 0.1 kw per capita of the world's population. This is very low. Under such conditions the burden of heavy physical labor is inevitable, especially in economically underdeveloped countries. The fact must also be taken into account that most electric power stations at present operate on coal, the production of which is dependent upon the heavy labor of miners.[2] An increased use of liquid and gaseous forms of fuel and fission materials will result not only in a rapid rise in the production of electric power, but in easier working conditions.

These means of obtaining electric power energy,

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[1] Electric power energy is useable in almost any technological process, and may be transformed into all other forms of energy. It may be conveniently transported over long distances, it may be subdivided at will into smaller components and, therefore, it may be utilized without much loss. Electric motors are the most efficient. Electric power energy permits the attainment of high speeds and a greater efficiency of processes. It permits greater precision in the conversion of materials and the automation of production.

[2] It is true that hydroelectric power stations do not have this disadvantage, but they require an enormous expenditure of labor in the course of construction.

however, are of much smaller significance than the gigantic possibilitães that will be available to humanity when controlled thermonuclear reactions are achieved and utilized on an industrial scale. The work of soviet physicists, followed by British and Amaericans showed that in principle this problem can be solved. There is reason to hope that the problem of the utilization of controlled thermonuclear reactions in the prednction of electiric power energy will be solved from an engineering standpoint as well, in the course of the next two to three decades. Nuclear synthesis already in this century, undoubtedly will become one the main sources of energy.

From a practical standpoint, unlimited raw material resources (water) as a source of thermonuclear fuel, the simplicity and safety of its manufacture, the enormous amount of energy it contains per unit of weight, the assumed possibility of direct conversion of thermonuclear energy into electric energy, the absence of dangerous radioactive matter in exhaust gases make the thermonuclear process truly an ideal method of producing energy, that can be obtained in any desired amounts, at any point on the globe and, if necessary, beyond its boundaries - in the unlimited reaches of the cosmos.

Apparently we will not be utopian if we

assume that already by the end of this century or at the start of the next, electric power energy in the world could be increased, for example, tenfold, i.e. attain a level of established power of 10 kw per capita. This will permit the elctrification of all forms of industrial production, of agriculture and in the home. With a further rise in electric power output, say, another tenfold increase, possibilities will become available for a rational control of the climate, since in that case the amount of energy produced in one year will already equal approximately 5 percent of the amount of solar energy absorbed by our planet over that period.

Energy is just one of the conditions of the production process and means of satisfying man's material requirements. Another important condition is that of the material, that today must meet strict requirements. Production is not only dependent on the consumption of energy, but also involves the use of specific production materials. Materials are the basic element of technical progress; they are fundamental to the means of production. Thus, entire historical eras of human development are characterized in science by the type of material that was used in that period: the stone age, the bronze age, the iron age.

Our era apparently may be viewed as eve of

the era of synthetic materials. Today we talk about creating essentially new materials that are not encountered in nature, with preselected properties. Synthetic polymers are such an ideal universally available material, that may be endowed with the most varied properties, that are an improvement over those of known natural materials.

Raw material resources available for the production of polymers, permit raising the production level of the latter dozens of times. One of the raw materials for polymers is petroleum, natural gas, as well as coal, wood, straw and the like. With an increase in the production of electric power energy by means of thermonuclear reactions, the consumption of petroleum, gas and coal for transportation, by industry and agriculture, as well as the use of coal for heating will be reduced to a minimum. Even at the present scale of production of fuel, this will make it possible to obtain hundreds and hundreds of millions of tons of synthetic materials.

If today a total of 20 to 25 million tons of synthetic and natural polymer materials are produced in the world (not counting cellulose used in the manufacture of paper), i.e. 10 kilograms per capita of the world's population, then the raw material resources mentioned above will make it possible to raise the manufacture of polymer

materials to 200 and 300 kilograms per capita. Synthetic polymers may fully satisfy human needs in clothing, footwear, textiles, household goods, construction materials and the needs of industry.

The bowels of the earth and the ocean depths are unlimited sources of raw materials. We are familiar with the structure of our planet to a depth of only 5 to 6 kilometers. A systematic study of the inner structure of the Earth not only will make possible the resolution of fundamental scientific problems, connected with the origins of the Earth, but will also open up new avenues for the exploitation of its contents. Extensive studies of the ocean depths likewise will be of great theoretical and practical value. Our present knowledge in this field is incomplete and fragmentary.

Man's primary requirement is food. A significant portion of humanity is at present underfed, and there are places on the globe where mass famine exists - that invariable companion of the laboring population. At the same time the mere improvement in methods of soil culture, fertilizing and irrigation of available arable lands up to the modern advanced agricultural engineering levels, would make it possible to ensure the availability of sufficient high quality foods for twice the present popu-

lation of the Earth. These possibilities are constantly growing, since the development of power engineering makes possible a large increase in the seeded area. The possibility of obtaining new and incomparably more efficient fertilizers in the future, also should be borne in mind. When the mechanism of heredity is discovered, men will be able to control it and will open new ways for the creation of various species of animals and plants.

These indicated prospects are but a natural development of already existing methods in agricultural sciences and actual practice. It is unquestionable, however, that in the next few decades science will probe some essentially new and much more productive methods of obtaining food. In the production of foodstuffs solar energy will, of course, be used as heretofor, for it is the most powerful energy source on the surface of the globe. Possibilities for its application will be constantly improved. Thus, it became known in recent years that gibberellic acids are unusually effective in speeding the growth of a series of plants, and sharply curtailing the entire period of their development. When science has thoroughly studied the mechanism by which such materials exert their effect, a real possibility will probably open up for a radical change in agricultural methods.

The question is raised of the use in the production of foodstuffs of the biomass of unicellular algae (Chlorella, for example), that contain a large amount of albumen and use solar energy with an efficiency of up to 10 percent.[1] By utilizing as raw material the albumens and carbohydrates of these algae, as well as the green pulp and wood of various plants, people will find a method of chemically treating them to convert them into specialized albumens, fats and carbohydrates suitable for foodstuffs, i.e., they will be able to complete the biosynthesis process outside living organisms. Naturally, existing chemical methods are inadequate for the solution of these problems. To obtain albumens and nucleinic acids of a given structure, it is necessary to know the mechanism of biocatalytic processes in the organism and create new more narrowly specialized but more effective biosynthesis catalyzers, that function outside of living organisms.

Further progress in chemistry and biology will make it possible to go further than merely expand human

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[1] As a reminder, cultivated plants (according to Nichiporovich) utilize by photosynthesis for the time being only 0.5 to 1.0 percent of the total amount of solar radiation energy falling on the seeded areas. (See "Herald AS USSR", No.9, 1954, page 26).

food sources. For example, it is possible to imagine in a realistic manner the creation of entirely new types of machines that will immediately and directly transform chemical energy into mechanical energy, in a manner analogous to the contraction and relaxation of muscular filaments.

We must not forget that in creating various structures of living matter, that perform the most complicated life processes, nature had at its disposal only very limited possibilities as regards the choice of raw material. The same "structural materials", pyramidine and purine base, for example, were used for the creation of structures that ensured both the mechanism of heredity and that of energy accumulation, necessary for metabolism, in particular, for muscular contraction. Armed with modern chemistry, people are much richer than nature in this respect.

In the last few decades amazing successes have been achieved in the field of chemotherapy, especially in connection with the discovery of antibiotics. Many fatal illnesses have been liquidated. The dangerous aspects of others have been substantially reduced. In recent years significant achievements have also been reached in surgery. With a tireless struggle for man's health, it will be possible in this century already to rid mankind of many illnesses that carry away men in the prime of life and undermine their

working ability. The time is not far when the problem of ensuring fullvalued longevity will be successfully solved.

At the present time a very rapid development of electronics and remote control engineering is taking place. In the near future this development will ensure the placing of basic production processes on a self-regulating basis. Problems of modern automation are being jointly solved by scientists in various branches of science: Mathematicians, physicists, chemists, mechanical engineers and so forth. It is important to note that logic plays an important role here. As a result of the rapid development of mathematical logic in the 20-th century, a special science has been developed, known as technical logic, that is concerned with the planning of discrete technical assemblies. The further development of this complex of science disciplines will undoubtedly lead to an enormous increase in the productivity of human labor. A real possibility is created for the future reduction of the working day to 3 to 4 hours. Man will have enough free time for various intellectual and artistic pursuits, for selfeducation and for physical culture.

Labor, which at one time created human society, is the basis of man's life and happiness. It is precisely by the process of creative labor that mankind conquers

the forces of nature, frees itself from the power of the elements, changes the aspect of the earth, reconstructs its life and itself. As science and engineering develop, labor acquires an ever growing aspect of creativeness. The continued improvement of labor actvity is evidenced, in particular, by the fact that man is freeing himself from exhausting physical toil, from tiring and monotonous work, based exclusively on the use of muscular power.

With the development of automation and electronic computers, the very character of production labor will undergo a change. Man will be freed from the direct control of technological processes, which is in substance of an automatic nature and that will be reduced to a reaction to very stereotyped signals on the course of the production process. In addition, electronic computers will free man from such types of intellectual labor that do not require creativeness and the nature of which is automatic.

The computer of the near future apparently will furnish sytematized information that has been already partially analyzed. This will significantly widen the scope of possible creative work by man, will rid his brain of the need to remember the initial analysis of factual material, that must be taken into account in modern scientific creative activity. It is precisely the uninterrupted

constant accumulation of scientific material, that is inevitable under conditions of rapid scientific development, that transforms scientists into very narrow specialists. Electronic machines are destined to do away with this paradox, and to enable intellectual forces to become concentrated on the actual process of creation to a much greater extent than is now possible.

Such are the tremendous possiblities opened up for mankind by scientific progress. Their practical application, however, may be ensured only under a social system that gives sufficient room for the productive forces of society to expand, and that places science at the service of the entire population. Socialism is such a system. Capitalism, on the other hand, not only delays the development of productive forces, it often leads to the destruction of enormous material values, and places science at the service of a selfish group of monopolists.

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There is a lively discussion on the pages of bourgeois journals and books concerning the problem of the social consequences of scientific progress, that increasingly occupies the attention of many foreign authors. This problem is both real and timely.

The practical application of atomic energy

has furnished a strong incentive for the development of the problem of relations between society and science. The very fact that modern science has created an unheard of means for the mass destruction of human beings was taken by many foreign scientists as proof of the antihumane and antisocial nature of sceince as a whole. An American sociologist expressed this point of view in the following manner: "For many of us science has become a "social problem", similar to poverty, juvenile delinquency, and people want to do something about this". (B.Barber, "Science and the social order", Glencoe, Illinois, 1952, page 208). Not only sociologists but ordinary people have come to view science and technology as some almost demoniacal forces, that are independent of human consciousness, are arrayed beyond society's reach and are harmful to society. Social opinion in Western countries is under the heavy influence of numerous groups of literary personalities such as O. Huxley and G. Bardet. It is known that Bardet, for example, in his much discussed book "Tomorrow is the year 2,000!", called on society to return to patriarchal conditions and to religious faith. He views modern science and technology as the sworn enemies of mankind (G. Bardet, "Demain c'est l'an 2,000!", Paris, 1952). It is little wondervthat many people in the West are certain that war or peace bewteen nations depend upon the

condition of modern military engineering as such.

The pessimistic view of science as force of evil rather than of good for mankind, has adherents even among prominent scientists. Thus, the well known biologist Darwin, the grandson of the famous scientist, has devoted one of his books to proving the following thought: "There are absolutely no grounds to expect noticeable progress in achieveing human happiness". (Ch. G. Darwin, "The next Million Years", London, 1952, page 162). A typical defender of this point of view is the leading American scientific personality D. Conant. He set forth his pessimistic conlu-sions in a book "Modern Science and the Modern Man" (New York, 1953).

The reason for the emergence of such concepts lie hidden in the faulty understanding of the really ugly features of scientific progress under capitalistic conditions. Important inventions and discoveries in this case, may often worsen peoples' living conditions, denying them the very benefits they themselves created.

A bourgeois scientist sees, for example, that an immediate result of the introduction of automation turns out to be unemployment. But he does not see, or does not wish to see, the relationship that exists between the social structure and unemployment. He does not wish to see the fact

that technical progress under socialism never leads to unemployment. He places all the blame on science and engineering as such. He is, of course, mistaken in arriving at this conclusion. The indissoluble link between society and science (and engineering) consists precisely and very particularly in the fact that technical development may lead to an increased social welfare and to a real improvement in living conditions not under all social conditions, but only under specific social conditions.

Problems of the "social consequences" of science, "social resposibilities" of the scientist and "society's control over science" are closely interrelated. Their discussion among bourgeois scientists shows that the latter are worried about the social cosequences of their discoveries. In this instance, scientists give a great deal of thought to the fact of the discovery of the atomic bomb, the use of which may play a fateful part in the mankind's future. They are literally grabbing at the concept of science and technology as independent forces, outside the social realm. At the same time, the discovery and use of atomic energy, perhaps as no previous discovery, has exposed science's social nature, the dependence of its development on the interests of society.

For example, is the American physicist R. Lapp

correct in his views of atomic energy as some sort of universal catatrophy, similar to a Martian invasion, that threátens the destruction of the USA and the USSR? (See Ralph E. Lapp "Atoms and People", NY, 1956, page 171). Of course, not. It is not atomic energy that is a danger to mankind, but the fact that Western powers have made it a means of threats and of frightening - a means of a policy of aggression. If atomic armaments could be forbidden, as has been constantly proposed by by the Soviet Union since 1946, then the atom bomb, with all the fears that it has caused, would cease to exist.

The peaceful use of atomic energy also depends on social conditions. Thus, for example, the use of atomic energy as a powerful means of rapid development for industries of technically and economically underdeveloped countries, is impossible without the goodwill and selfless aid of highly developed industrial powers, because the creation of atomic energy power requires enormous capital investments, a high level of machine construction and instrumentation, highly qualified staffs and so forth.

Historical experience shows that highly developed capitalistic powers are not interested in the many-sided industrial development of economically underdeveloped countries. They try to transform them into suppliers of

raw materials and consumers of finished products. The industrial use of atomic energy, on the other hand, requires the manysided development of the technical base of the country. It is not surprising, therefore, that many Western sociologists are sceptical about the possibilities of narrowing the gap between economically higly developed and underdeveloped countires by the widespread use of atomic energy. (See, for example, W. Isard and W. Whitney "Atomic power, an economic and social analysis", NY, 1952, pages 187-218).

If we take other areas of application of scientific achievements, for example, the longterm prospects for a meaningful climate and weather control, we see even more clearly the dependence of these possibilities on social conditions. The nature and scale of this undertaking are such that it can be achieved only by the planned and coordinated actions of mankind as a whole, and its objective can only be the satisfaction of the material needs of man.

The problem of the scientist's resposibility for the social consequences of the practical application of his inventions is very complex. This is explained by the fact that modern science and technology allow virtually any invention or discovery to be used for military purposes. If in the preceding century it was relatively simple to draw the line pretty clearly as between military and purely

industrial inventions, such a line now becomes vague. This is especially characteristic for such new branches and trends of technical development as atomic power energy, cybernetics and automation.

Under these conditions it becomes clear that the social structure and the social groups that are in power, carry a respesibility for the directional trend of research and investigation as well as for the practical realization of the results of these investigations. They are responsible, in particular, for the utilization of the power of the atomic nucleus for military purposes, or for the application of cybernetic instruments for military type computations. For this reason it is laughable to pose the problem of "control over science". What needs to be controlled are the actions of people and groups on whom the application of scientific knowledge in society is dependent. It is clear that in a society where the power rests in the hands of the people, the establishment of such a control is not a difficult problem.

The well-known mathematician N. Viner proposed that scientists organize, so to speak, a system of "self control": not to publish a single line of something that could serve the cause of militarism. This noble but naive hope can never be achieved. Viner was faced with the justified

objections to the effect that in that case a modern scientist would have to give up any preparation of conclusions of his work generally. B. Russel, proposing that science continue to develop without a parallel development of industry, apparently was himself well conscious of the utopian nature of his project. Such proposals disregard the fact that the entire complex of the social and antisocial nature of modern science, of its resposibility to mankind, of its service for the welfare of man etc, in the light of the realities of social existence, are beyond the framework of the competencies of scientists. It is evident that scientists, as members of society, and as the best informed regarding the capabilities of science, must fight for its utilization in the interests of social welfare and of mankind as a whole. But they must renounce the view that science is a force that is independent of society. Otherwise, their sicere desire to shield mankind from the dangers inherent in modern scientific achievements will lead to the sad and well known slogan of several Amaerican scientists and sociologists about the need to announce a moratorium on discoveries and inventions.

There is another no less important aspect of the close ties existing between society and science (and engineering). Modern science and technology clearly

prove that the tempo and possibilities of their development depend in large measure on the nature of the social relationships in a given society. Let us again turn, for example, to modern production automation. The general introduction of automation changes the substance of the labor of the worker. He is no longer, in a manner of speaking, an apprentice of the machine, who watches only that it continue working without interruptions. The worker retires ever further from a direct participation in technological processes and concentrates his efforts on the general management of the production process. In this way, from a technical standpoint, a worker is no longer an addition to the machine. In the case, however, where he remains as such an addition, i.e. where the machine that he directs personifies an economic force with which he is not familiar and that is beyond his controlling power, an obvious paradox appears.

The control of an automated production process, as no other form of productive labor, requires on the part of the worker initiative, selfreliance and a creative attitude towards his labor. He must be conscious of the great responsibility that is his in the making of decisions. The worker must himself control his own actions and be deeply concerned with the efficiency of the entire system of machines. How can a worker, stepping on to the threshold of an automated factory

for the only purpose of receiving pay for his work, have such an attitude toward labor, if, in addition, the development of automation, as any other rationalization of production, threatens him with the loss of his job? This question is answered in the negative even by some bourgeois specialists (See, for example, Edward C. Bursk "Human relations for management; the newer perspective" NY, 1956, pages 34-35).

A worker on a production that is automated must become the machine's master, and must manage it not only from a technical standpoint but in an economic way as well. Only this can gurantee a creative attitude on his part toward his work. This mastery of man over machine, such a creative attitude toward labor are possible only under conditions of a socialist society.

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Science in the 20-th century is no longer a business for the lone wolf. Characteristic of its development in the last decades has been the fact that the work of scientists in this or that form is being planned and directed by society. This is an obvious fact. Many bourgeois scientists and sociologists, nevertheless, deny this and speak of science's independence and the independence of its development from society - "the creative freedom" of the scientist.

Typical in this regard is the argument of the British zoologist J. Baker. "Art, music and science - he writes - have their own objective as a primary function, and as a secondary function to make the intellect less helpless and more proud, and in that way to help in the solution of problems not related to them, by, for example, giving solace in misfortune" (John R. Baker "Science and the planned State" NY, 1945, page 102).

One of the principal arguments in favor of such views is the assertion that scientific development seemingly depends only on the creative intuition of the scientist, on the "freedom of his creation", which, by its very nature, brooks no outside interference. Defending this thesis, a series of Western scientists sharply attack all planning concepts in scientific investigations. Any attempt to include scientific research into an overall national plan is identified by them with"coercion" of "free science", with "totalitarian methods" of control over science. Scientists, in the opinion of certain Western thinkers, are supposedly unbiased seekers after eternal truth, and are independent of society and its demands.

What can be said of that conception?

The very concept "individual freedom of the scientist", "freedom of creative actvity" in this context

becomes fictional. This is especially obvious at the present time. Since a researcher lives in society and is a member of it, it is precisely that society that in this way or that determines the direction of his creative activity. The concept of lone-wolf scientific geniuses, at their desks or in makeshift laboratories determining the fate of science is hopelessly oldfashioned and has become today an anachronism. Creative scientific activity in the realm of natural sciences requires that the scientist have at his disposal both a siseable staff and considerable means that are given him by the government or by private persons.

Science in all countries is directly or indirectly subsidized by production or by the government. In capitalistic countries scientific research in a large measure is determined by the interests of private firms, and is dependent on the competitive struggle between these firms. Scientific research is often financed by private individuals, by various types of contributors to charities, who sometimes interfere themselves in the business of science. Such are the realistic facts of life. Therefore, to talk about the fact that science is "free" from the demands and needs of society, is to be, at least, superficial. In the USSR, both the goverment and society plan the scientific research front and the pricipal directions of the work of

soviet scientists are included in the general economic plan. Indeed, the successful development of modern science and technology, requires precisely that type of centralized and coordinated direction.

Science cannot but serve society and be dependent on it. Whether scientists like it or not, science will always be one of the forms of social development. The conscious planning of science on a national scale merely serves to to express and confirm this objective situation.

Intuition, creative phantasy, the willfull and purposeful actions of leading scientists always have, of course, an important value. But at the present time the talent of a leading scientist is mainly evident in the work of the collective of which he is a part, through the school that he has created, through his ties with production.

Does such a form of activity limit the opportunities for individual creative achievements? Certainly not. On the contrary, as experience in the USSR proves, it serves as an unusual stimulus to the scientist's initiative, if, of course his thoughts are directed toward the solution of scientific problems of real importance. The government actively starts to assist him. In back of him appears a whole army of pupils and colleagues who, being

enthusiastic followers of his ideas, freely and with enthusiasm develop his hypotheses and theories, so that the talented scientist's ideas lead more speedily to scientific, followed by practical results. That is the way in which the question of the "freedom of creative activity" is understood by soviet scientists.

At times the arguments of Western scientists regarding the "freedom of creative activity" are oriented directly against the organization and the position of science in the USSR. Ten years ago certain American scientists were trying to prove that our country had chosen, as it were, the wrong road for the development of its science. One such scientist wrote: "Despite the phantasies of scientific reformers in Russia and outside Russia, I am conviced that a dozen scientists enjoying freedom for research and explanation of the facts of nature are of greater value to society than thousande organized for the solution of a specific problem" (Science" vol.109, No.2837, 1949, page 478). It is true that in recent years there have been fewer such expressions, and their number is diminishing. And this is not surprising: the brilliant successes of soviet science have convincingly proved its advantage and the progressive nature of its organization. They have shown that the planning of scientific work, the collective spirit

not only do not impede, but, on the contrary, stimulate the individual initiative of scientists and the solution of fundamental scientific problems.

In the opinion of certain Western scientists, our state and our society are directing science along strictly applied scientific lines, that serve to definitely limit creative free activity. But that is not at all in accordance with reality. Actually it is precisely here, in the USSR, that the possibilities for the free exercise of their creative abilities are ensured to scientists to a greater extent than anywhere else. And this is true not only in the sphere of the application of science to the national economy, but in the realm of research on fundamental scientific problems as well.

Almost immediately following the Great October revolution, the attention of the Soviet state and of the Communist party were directed toward the creation of all necessary conditions for the development of the theoretical bases of our science and technology. In the years 1919 and 1920 the Institute of academician Pavlov, the Institute of academician Ioffe and a series of other institutes were organized, for the purpose of developing the theoretical bases for mathematics, physics, biology. The work initiated by scientists in the field of scientific theories, even in

instances when it was not directly linked to problems of an applied nature, was widely supported by our government and by the party.

It goes without saying that our scientists always strove and now strive to be of use to their government and their people. They participate according to their abilities in the national objective of building a communist society. In this unity with the people they saw and continue to see a full embodiment of their own aspirations, their initiative, their creative activity. That is, after all, the principal source of strength of our science. And it is this simple truth that the eduacted people of the West still cannot understand.

There is another important aspect in the understanding of the problem of "freedom of creative activity" of the scientist. Broad scientific research possibilities are all the better ensured when there is a large number of persons interested in and having an ability for scientific pursuits, and who can thereby realize their creative aspirations. Here too the advantage of the organization of scientific work and scientific training in the USSR and other countries of socialism, as compared to that of capitalistic countries, is clear.

Any person in our country, if he wants to study, may obtain a higher education. Upon graduation from an institution of higher education, or its evening courses, a young man who has shown an aptitude for scientific work and has displayed knowledge, may always enter one of the numerous scientific institutions of the country.

The socialist structure of society contributes to the maximum degree possible in the development of a scientist's own initiative, to the development of science and in the application of its achievements for the welfare of man. This is precisely what explains the outstanding achievements of soviet science, that hardly anyone abroad will deny. On a background of today's require- ments of technical development, the priciples of free enter- prise and the battle between competitive monopolists appear as a complete anachronism. The future fate of the old fashioned principles of economic life is obvious. They are destined to destruction.

The society of the future is based on prin- ciples of collectivism and rational planning. Only under such conditions does science acquire unlimited development possibilities and does it serve as an unprecedented source of social welfare.

2166

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